South Dakota AFNR

Academic Integration Activities: Example #15

→ *Environmental science students use graphs to express functions.*

1. Ag Standard

Environmental Sciences ES1.3

Analyze population Dynamics.

> Test the carrying capacity of a sample ecosystem.

2. Academic Standard

9-12.A.4.1

Students are able to use graphs, tables, and equations to represent linear functions.

3. Background Information

Linear equations are a fundamental component of Algebra class.

This cheat sheet will help refresh your memory:

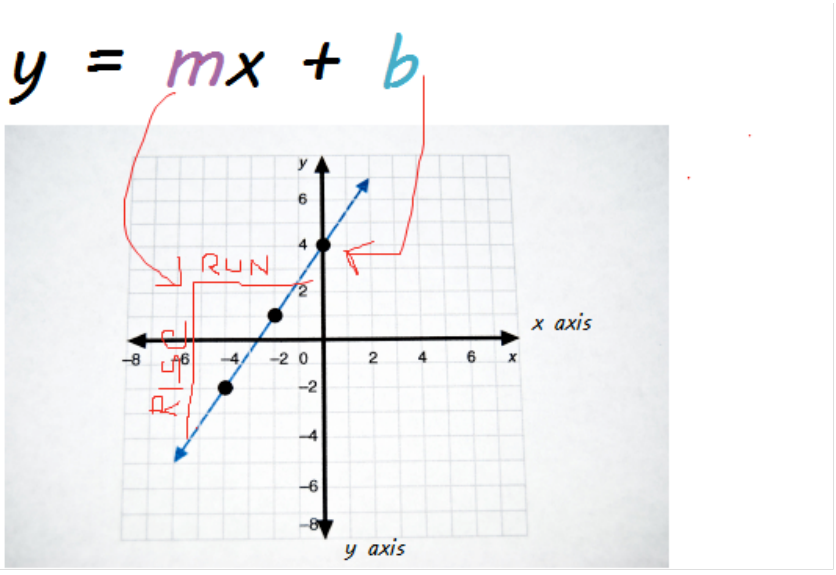
y = mx + b

y = The height/distance above or below the horizontal zero line at any given spot along the line.

m = The slope of the line, which tells us how steep the line is and is typically written in the fraction form rise/run.

x = The distance to the right or left of the vertical zero line.

b = The spot where the line crosses the y axis (vertical one).



For additional assistance, search "linear equations," and you will find pictures, notes, and videos to help you brush up.

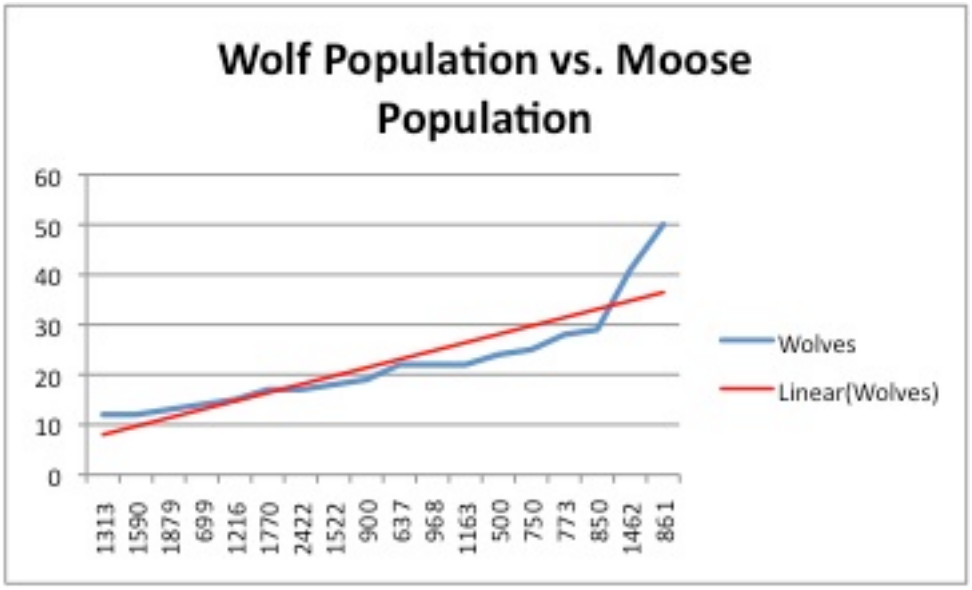
4. Example in Context

Define and discuss the concept of an ecosystem's carrying capacity.

- > Discuss limiting factors that can influence population growth.
- > Carrying capacity is not ultimately a number, but instead a relationship between population size and limiting factors affecting a species population growth.
- > A line graph is an excellent way to visually analyze how a limiting factor can affect an ecosystem's carrying capacity for a given species.

Share the example below to demonstrate an example of a carrying capacity graph.[1]

The graph below was produced from a table of data measuring how moose population influences the carrying capacity of wolves on Isle Royale (the largest island in Lake Superior). The limiting factor here is food. (Moose are a food source for wolves.)



- > Demonstrate how the points were plotted using the data table.

[1] Simplified from *Canyon Crest Media Center's* located at: http://teachers.sduhsd.k12.ca.us/cschildhouse/APBio08-09/3_Ecology/PopEcolGraphs.pdf.

Moose	Wolves
1313	12
1590	12
1879	13
699	14
1216	15
1770	17
2422	17
1522	18
900	19
637	22
968	22
1163	22
500	24
750	25
773	28
850	29
1462	41
861	50

- Label components of the graph
  - y-axis
  - x-axis
  - y-intercept
  - x-intercept
  - Slope (rise or run) or rate of growth
- Explain the concept of a best fit line or trend line when analyzing linear data.
  - Pose the question: What are scientists interested in knowing given this graph? (rate of population growth or decline, the relationship between the limiting factor and population growth, the point at which the population peaked, etc.)
- Ask and guide students through the following questions:
  - When the limiting factor is in abundance (or not so limiting), which direction does the line go?
  - What is represented along the y-axis? What about the x-axis?
  - Discuss the relationship between variables. Have students verbally fill in the blanks: "As _____ increases the population of _____ _____."
- Remind students of the algebraic formula for a line. Connect the concept of the linear equation and how it relates to the above items.
  - x-axis:
  - y-axis:
  - m or slope
  - b or y-intercept (may or may not be present, but define)
  - x-intercept
  - Review the term "slope" and how it is calculated by looking at rise/run. Demonstrate how you would calculate slope for this example.
  - Write out the formula for the best fit line in the example in the linear equation format and review.

5. Guided Practices

Have students work in groups to plot data to form a line graph and analyze the meaning of the data.

Provide students with the following data table and small group, in-class assignment:

- Create a line graph using the data below.
- Label each axis.
- Calculate the slope of the line.
- Write the linear formula representing this data set.
- Write a sentence or two explaining the relationship between acres of land and prairie chicken population.

acres	prarie chicken population
1000	13
2000	26
3000	39
4000	52
5000	65
6000	78
7000	91
8000	104
9000	117
10000	130

6. Independent Practices

Have students complete an example individually. Repeat the assignment as listed in the previous example independently using the following sample set of data:

Antelope	annual AUM available
10	24
14	33.6
18	43.2
27	64.8
33	79.2
38	91.2
47	112.8
52	124.8
55	132
61	146.4

7. Notes

If the concept of best fit line is difficult to grasp or appears too time consuming, the data in the first example could easily be simplified to create a perfect line.

Additional examples of actual population data can be found using a simple online search.